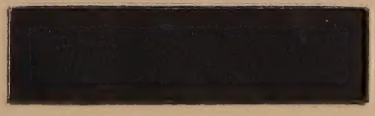
# LAN-ELECTRONICS LTD.

## TECHNICAL DATA



97 FARNHAM ROAD, SLOUGH, BUCKINGHAMSHIRE

SLOUGH 21231, 26447

MP MASTER

MA23305

ET-2053

POWER UNIT LP-411/P

67. 3053

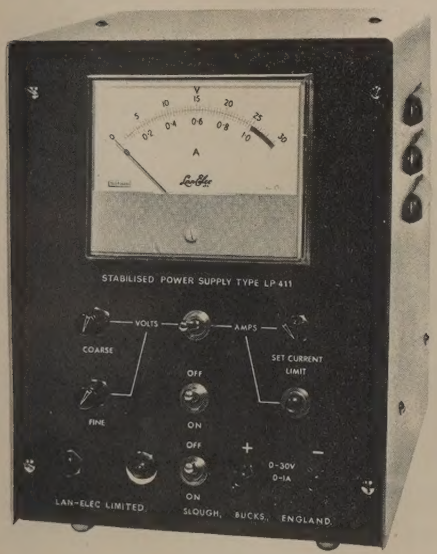
BULLETIN No. 43B.

# LAN-POWER

**RANGE OF HIGH-QUALITY STABILIZED LOW-VOLTAGE POWER SUPPLY UNITS**

## 400-P SERIES BENCH TYPE, METERED

**SERIES AND PARALLEL OPERATION FOR MAXIMUM FLEXIBILITY**




LP411/P. 1 Amp.

* FULL REMOTE CONTROL. PARALLEL OPERATION OF UP TO THREE UNITS.
* SERIES OPERATION OF TWO UNITS PROVIDING 0-60 VOLTS AT 1 AMP.
* CONSTANT VOLTAGE - CONSTANT CURRENT, WITH AUTO CHANGEOVER.
* CONTINUOUSLY VARIABLE VOLTAGE AND CURRENT CONTROLS.

The L.P. 411/P is a 1 Amp. version of the type L.P.401/P but is otherwise identical in terms of stability, ripple and output resistance. Up to three 411/P units may be connected in parallel to provide 3 Amps at 30 volts. Any unit may be switched to Master and the Slave units will automatically follow voltage adjustments to this unit. Two units may also be connected in series to provide 0-60 volts at up to 1 Amp. The type 401/P 0.5 Amp. and 411/P 1 Amp. units may be 'mixed' in parallel, up to three in number. Constant current settings must be set individually and subdivided between units in parallel if high accuracy is required. Constant current may be set on each unit in the range 100mA to 1 Amp. by a continuous front panel control. Setting is monitored by front panel meter. The Constant Voltage-Constant Current circuits ensure complete protection for sensitive circuits of all types.

Similar units to the 400 P series are available without parallel facilities, at slightly lower cost. See price list.

**LAN-ELECTRONICS LIMITED 97 FARNHAM ROAD, SLOUGH, BUCKS. Tel: 26447/8**

SPECIFICATION

| | |
|---|---|
| Output Circuits | The output control circuits operate in the constant-voltage - constant current modes with autochange-over. Two or three units may be connected in parallel.<br>Any one unit may be switched to Master when the Slave units will accurately follow voltage adjustments made to this unit. |
| Series Connection | Two units may be connected in series to provide 0-60v. at 1 Amp. |
| Voltage Fine<br>Course | The fine control has a range of $\pm$ 0.75v.<br>The course control has a total range of 0-30v. continuous. |
| Output Current | 1 Amp. maximum. The unit is continuously rated at full load. Current is monitored by panel meter. |
| Terminals | Standard 7 mm terminals are isolated from chassis. Either polarity may be taken to earth. The insulation resistance is greater than 100 M. |
| Constant Current (single unit) | Constant current is adjustable continuously from 100mA to 1 Amp. by front panel control. The setting is monitored by front panel meter.<br>Changeover from constant voltage to constant current is automatic and extremely accurate.<br>The unit will withstand prolonged short circuits at full rated current without damage. |
| Line Stability | Better than 3,000:1 for +10% main input variation. |
| Output Resistance | Less than 10 milliohms. |
| Ripple and Noise | Less than 500 microvolts r.m.s. |
| Ambient Temperature | The unit will operate at full load in ambient temperatures up to +45°C. |
| Mains Input Voltage | 100 to 120v. 40 to 60c/s. and 200 to 250v. 40 to 60c/s. |
| Dimensions | $8\frac{1}{4}$" wide, $10\frac{1}{2}$" high and $9\frac{1}{2}$" deep. |
| Weight | 13 lbs. |
| Finish | Maroon anodized front panel.<br>Case - silver grey polychromatic stove enamel. |

This specification is typical of an average instrument, and we reserve the right to introduce modifications at any time without notice.

# THE NEW L.P. 400 SERIES

## LOW VOLTAGE HIGH STABILITY PRECISION BENCH TYPE

## CONSTANT VOLTAGE - CONSTANT CURRENT

## POWER SUPPLY UNITS

The L.P. 411 stabilised metered power supply is one of a new range of high stability, low cost, precision units with a standard of performance comparable with instruments in a much higher price bracket.

0.5 amp versions are available with single and twin outputs, the performance specification being similar in each case.

Voltage, current, and the fully adjustable constant current setting, are monitored on the large $3\frac{3}{4}$" clear scale panel meter without recourse to range switching.

The coarse and fine voltage controls facilitate precise vernier adjustment of the output, the fine voltage control having a total range of $\pm$ 0.75 volts at all output levels.

Particular attention has been given to the design of the constant current control circuits, which provide extremely sensitive stable and accurate control of current limiting over a very wide range, thus ensuring complete protection for sensitive equipment of all types.

All the units in the 400 Series will withstand prolonged short circuiting of the output, without damage.

The L.P. 400 Series power units are small, light, and attractively finished with Maroon Anodised front panels and Polychromatic Silver Stove enamelled cases. All internal metal parts are anodised Black.

Rack mounting versions are available to special order.

LAN-ELECTRONICS LTD.

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# PRECISION LABORATORY LOW VOLTAGE STABILISED D.C. POWER SUPPLY UNIT TYPE L.P. 411 (Single) BENCH TYPE METERED

OUTPUT CIRCUITS — The output control circuits operate in the constant voltage—constant current mode.

VOLTAGE — 0-30 V D.C. Continuously variable in one range with precise vernier adjustment. Voltage setting monitored by the large $3\frac{3}{4}$" clear scale panel meter.

ADJUSTMENT - FINE — The fine voltage control has a range of ± 0·75 volts.
COARSE — The coarse control has a total range of 0-30 volts.

OUTPUT CURRENT — 1A maximum. The unit is rated for continuous operation at full load. Current is monitored by the panel meter.

The output terminals are isolated from chassis and either pole may be connected to earth.
The insulation resistance of the output terminals to chassis is greater than 100 megohms.

OVERLOAD PROTECTION — The electronic constant current setting is variable from 100 mA to 1 amp in one range; adjustment is by front panel control. The constant current setting is monitored by the panel meter.

CONSTANT CURRENT CHARACTERISTIC — With the output terminals short circuited at any constant current setting below 200 mA, the rise in limiting current is less than 7%. Similarly, at any constant current between 200 mA and 1 amp the rise in setting with short circuit output is less than 3%. The constant current circuit will return precisely to the original setting when the overload is removed.

LINE STABILITY — Better than 5000:1 for ± 10% mains input voltage variation.

OUTPUT RESISTANCE — Less than 10 milliohms.

2 cont...

| | |
|---|---|
| RIPPLE AND NOISE | Typically less than 500 microvolts peak to peak. |
| RELIABILITY | The L.P. 411 will withstand prolonged short circuit of the output terminals without damage. |
| OPERATING TEMPERATURE | The unit will operate continuously at full load in ambient termperatures up to +45°C. |
| MAINS INPUT VOLTAGE | 200 to 250 volts, 40 to 60 c/s in preset ranges. |
| DIMENSIONS | The instrument measures 8" wide by 10·5" high and 9·5" deep overall. |
| WEIGHT | 12 lbs. 10oz. |
| FINISH | Front Panel : Maroon Anodised.<br>Case : Polychromatic Silver Stove enamel. |

The L.P. 401 single and L.P. 401T twin 0·5 amp have similar specifications to the above.

This specification is typical of an average instrument and we reserve the right to effect modifications.

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# STABILISED POWER SUPPLY UNIT

## TYPE L.P. 411

## OPERATING INSTRUCTIONS

MAINS TAP set for 240V

Ensure mains tap setting is correct for the supply voltage. Normally delivered set to 240V, (adjustment - 10. 0. 200. 220. 240V on mains transformer). The unit is ready for operation immediately after switching on. The three core mains cable attached to the instrument is coded as follows: Red, Line. Black, Neutral. Green, Earth.

With the meter range switch set to V, volts, the voltage appearing at the output terminals is monitored on the meter. Similarly, with the meter switch set to A, amps, the current being drawn will be shown.

Constant Current Setting

With the meter switch set to A, amps, the 'Set Current' push button switch should be depressed, thus short circuiting the output. The Set Current control knob can now be adjusted to the required constant current setting which will be monitored on the panel meter. The Set Current knob and push button are so placed to enable operation of both controls with one hand, the push button operated with the third finger of the hand and the knob with the thumb and index finger.

The unit reverts to normal operation immediately the Set Current push button is released.

The LP 411 operates in the constant voltage mode until the load current reaches the value set by the Set Current controls; at precisely this point the unit reverts to constant current and the load current will remain at the chosen value whilst the voltage will tend to drop towards zero depending on the load resistance.

The outputs are completely independent and may be connected in series to provide 0-60V at 1 Amp (when using two type LP 411).

Note, the output circuits are not suitable for parallel operation although accidental parallel connection will not damage the unit.

# LP 400/P SERIES
# LP 401/P LP 411/P and LP 401T/P
# PRECISION STABILIZED LOW VOLTAGE D.C.
# POWER SUPPLY UNITS
# FOR SERIES OR PARALLEL OPERATION.

## INTRODUCTION

The LP 400/P series power supply units are a development of the LP 400 models with additional remote control facilities for parallel operation with a maximum of three units connected together. Provision for series operation of two single units is provided as standard throughout the range.

The maximum power output of each unit is as follows:-

TYPE

LP 401 and LP 401/P. 0 - 30 volts @ 0•5 AMP (single)

LP 411 and LP 411/P. 0 - 30 volts @ 1 AMP (single)

LP 401T and LP 401T/P. 0 - 30V x 0 - 30V @ 0•5 or * 1 AMP (twin)

Remote control parallel operation is provided in the 400/P series units by a rear mounted MASTER/SLAVE switch. The type LP 401/P and 411/P units have in addition a standard 6 mm terminal adjacent to the MASTER/SLAVE switch for remote control sensing.

A special feature of these units is their ability to monitor voltage and current simultaneously in either mode of operation.

## GENERAL DESCRIPTION - LP 400/P SERIES.

TABLE I

The 400/P units have three modes of operation as follows:-

| | |
|---|---|
| (a) Type LP 401/P single. 0-30 volts @ 0•5 AMP ) | |
| " LP 411/P " " " " @ 1 AMP ) | NORMAL OPERATION |
| " LP 401T/P twin. 0-30Vx 0-30V @ 0•5 A or *1 AMP | NORMAL & PARALLEL |

(b) Type LP 401/P single 0-60 volts @ .5 AMP Maximum) TWO UNITS
" LP 411/P " " " " @ 1 AMP " ) IN SERIES
" LP 401T/P twin " " " @ 0.5 AMP " One unit, outputs in series.

(•) Type LP 401/P single 0-30 volts @ 1.5 AMP Maximum) THREE UNITS
" LP 411/P " " " " @ 3 AMP " ) IN PARALLEL
" LP 401T/P twin " " " @ 1 AMP " One unit, outputs connected in parallel

MAXIMUM UTILISATION

Type LP 401/P and LP 411/P. Two units in SERIES or three in PARALLEL.
" LP 401T/P. One unit only. Outputs connected in SERIES or PARALLEL.

LP 400/P SERIES OPERATING INSTRUCTIONS.

1.1

The SERIES-PARALLEL control circuits are common to all three types and operation in either mode is as follows:-

LP 401/P and LP 411/P. SERIES OPERATION .....

A maximum of two units may be connected in series to obtain 0-60 volts. The output terminals MUST be connected in series EXTERNALLY and the MASTER/SLAVE switch set to MASTER on both units.

The output voltage of each unit is additive and should be set up individually e.g. 30 volts set on unit A and 15 volts on unit B will result in 45 volts. In this mode of operation the maximum load current can not exceed that specified for a single unit (refer to table I.b.

ADJUSTMENT OF THE CONSTANT CURRENT CONTROL.

1.2.

The SET CURRENT LIMIT controls determine the value of load current at which the unit will change from the CONSTANT VOLTAGE mode to CONSTANT CURRENT, and should be set up as follows:-

(a) Set voltage to the desired value with the meter switch at V.

(b) With the meter switch set to I press the SET CURRENT LIMIT button and adjust the knob above it until the meter indicates the required maximum source current.

(c) Release the button and the unit is now ready for use. The meter switch may now be returned to V and the unit will change automatically from constant voltage to constant current when the load current reaches the selected value, and will revert to constant voltage when the load current is reduced. The action of this circuit is rapid and extremely accurate affording maximum protection against overload for sensitive apparatus of all types.

Type LP 401/P and 411/P. PARALLEL OPERATION.

1.3.

For PARALLEL OPERATION a maximum of three units may be used with their output terminals connected in parallel EXTERNALLY (see table I.c.) and the following procedure should be adopted:-

(1) Switch one unit to MASTER and the remaining units to SLAVE.

(2) Connect a lead between the remote sensing terminals of the MASTER and SLAVE units (this terminal is adjacent to the MASTER/SLAVE switch and projects through the Back cover).

(3) Connect two or three units in parallel with suitable cable between the output terminals.

(4) Adjust the MASTER unit to the required voltage with the meter switch set to V, and note the SLAVE units follow, and indicate the same value ($\pm$ meter accuracy).

(5) Turn the SET CURRENT LIMIT control fully clockwise on all units.

(6) Set meter switch on all units to I and adjust the SET CURRENT LIMIT control with the PUSH BUTTON IN on each unit in turn, bearing in mind the current settings are additive, e.g. 300mA limit on the MASTER, 300mA on SLAVE unit I and 300mA on SLAVE unit 2 will result in a maximum source current of 900mA, which is the point at which constant current operation will begin. For accurate operation of the CONSTANT CURRENT circuits the desired maximum load current should be sub-divided between the units.

The SET CURRENT LIMIT controls may, of course, be left at maximum for full rated output (see table I.c.)

(7) Set MASTER unit meter switch to V and either SLAVE unit meter switch to I, when voltage and current will be monitored simultaneously. The current shown on any one unit will be identical with that of any other only if the load current is below the SET CURRENT LIMIT of all units, in which case the current indicated should be multiplied by the number of units in use.

1.4 TABLE II

The range of constant current or 'current limit' setting is continuously variable as follows:-

Type LP 401/P 45mA to 550mA )
" LP 411/P 100mA " 1.1 AMPS) typical values for an average instrument.
" LP 401T/P 45mA " 550mA )

LP 401T/P Twin OPERATING INSTRUCTIONS.

1.5.

Operation of the LP 401T/P unit is slightly different from the LP 401/P and LP 401T/P units in that only one unit may be used in either SERIES or PARALLEL.

The connections for either mode of operation must be made EXTERNALLY and the control switch at the rear of the unit should be set to NORMAL for normal and SERIES operation and to PARALLEL when maximum current is required. Setting up procedure is as follows:-

NORMAL OPERATION.

1.6.

(1) NORMAL - PARALLEL switch at rear of unit set to NORMAL.

(2) Meter switches set to V, adjust voltage to the desired value for each output.

(3) Set meter switches to I and adjust the SET CURRENT LIMIT controls as in section 1.2. The outputs are completely independent and may be connected in series externally when the voltage settings are additive.

(4) With the left hand meter switch to V and the right hand meter switch to I, voltage and current are measured simultaneously, the maximum load current is 0.5 AMP per section for NORMAL operation and 0.5 AMP total when connected in SERIES.

PARALLEL OPERATION

1.7.

The output must be connected in PARALLEL EXTERNALLY and the following setting up procedure adopted:-

(1) Control switch set to PARALLEL BEFORE SWITCHING ON.

(2) Meter switches set to V. The left hand section automatically becomes the MASTER UNIT and the right hand section the SLAVE.

(3) Adjust voltage on the left hand section and note the SLAVE section follows.

(4) Meter switches set to I, adjust each SET CURRENT LIMIT control in turn, as in section 1.2., to the desired value. The source current from each section being additive.

(5) Set left hand meter switch to V, and right hand meter switch to I. Voltage and current will now be monitored simultaneously and the current reading should be multiplied by two.

The LP 400/P series power units are completely foolproof and no damage will result from intermittent incorrect connections to the output terminals in either series or parallel modes.

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Tel : 26447/8

# POWER UNIT TYPE LP 411

## Calibration Procedure

1) Check that the mains supply voltage is correct for the power unit mains tap setting (normally set to 240 volts). Switch the Unit On and verify that the neon lamp lights.

2) Check V1 - V5 are within the limits set down in Table I.

3) With an AVO meter model 8 set to 100V DC range connected to the power unit output terminals, adjust RV3 (fine) and RV4 (coarse) voltage controls on the front panel to maximum. Adjust RV5 until the meter reads 33 volts.

4) Adjust RV4 coarse voltage control to 30 volts, as monitored with the AVO 8.

5) Connect a variable load resistance in series with AVO 8 - set to 10 Amp DC range, across the output terminals of the power unit.

6) Adjust RV1 (set current) front panel control to maximum. Set RV2 (preset) to maximum. Front panel meter switch to V. Increase load resistance to read 1 Amp on AVO 8. Adjust RV2 until the voltage reading on the power unit meter just begins to fall.

7) Short circuit the load resistance and set RV2 so that the AVO meter reads 1·1 A.

8) Seal RV2 and RV5. The Power unit is now ready for normal use. Should any irregularities be observed, consult Tables I and II overleaf. Tolerance on values shown should be ± 10%.

## TABLE I

| | | | | |
|---|---|---|---|---|
| V1. | Junction of | MR7 and MR8 .. .. | +43·5 | 100V Scale |
| V2. | " " | R1 and C4 .. .. | + 2·1 | 10V " |
| V3. | " " | R2 and C5 .. .. | -20·5 | 25V " |
| V4. | " " | DZ3 and R17 .. .. | -14·8V | 25V " |
| V5. | " " | DZ1 and R30 .. .. | -7·0 | 10V " |

All measurements made with AVO 8 + terminal connected to Power Unit negative output terminal.

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## TABLE 2

| | | | | |
|---|---|---|---|---|
| V6. | Base of VT1 .. .. | -13·0V .. .. | 25V Scale | |
| V7. | Emiter VT2 .. .. | -12·8V .. .. | " | " |
| V8. | Base of VT3 .. .. | -1·65V .. .. | 2·5V | " |
| V9. | " " VT4 .. .. | 1·60V .. .. | " | " |
| V10. | " " VT5 .. .. | 1·43V .. .. | " | " |
| V11. | " " VT6 .. .. | 1·05V .. .. | " | " |
| V12. | Collector VT7 .. .. | 1·07V .. .. | " | " |
| V13. | Emiter VT6 .. .. | 1·3V .. .. | " | " |
| V14. | Base of VT8 .. .. | 1·5V .. .. | " | " |
| V16. | Collector VT9 .. .. | -2·0V .. .. | " | " |
| V17. | Base of VT10 .. .. | -0·1V .. .. | " | " |

All measurements to be made with Power Unit set to 15V output. Load current 500 mA. Constant current set to 600 mA.

# DO NOT SCALE

UNLIMITED DIMENSIONS TO BE WITHIN ± ·005"
FRACTIONAL ± 1/64"

| Cir.Ref. | Description | Manufacturer | Value | Rat. | Tol.% |
|---|---|---|---|---|---|
| S1 | Switch Toggle | N.S.F. | 8373/K8 | | |
| S2 | Switch Toggle | N.S.F. | 8373/K8 | | |
| S3 | Switch Toggle | N.S.F. | 8373/K8 | | |
| S4 | Push Button | Radiospares | "Push-to-Test" | | |
| F1 | Fuse | Belling-Lee | 2.5 A | | |
| LP1 | Lamp | Carr Fastener | 79/619R | 250 V | |
| T1 | Transformer | Ferro-Mag | FM 512 | | |
| MR1 | Rectifier | Motorola | IN 4001 | | |
| MR2 | Rectifier | Motorola | IN 4001 | | |
| MR3 | Rectifier | Feranti | ZS 70 | | |
| MR4 | Rectifier | Feranti | ZS 70 | | |
| MR5 | Rectifier | Motorola | IN 4001 | | |
| MR6 | Rectifier | Motorola | IN 4001 | | |
| MR7 | Rectifier | Feranti | ZS 70 | | |
| MR8 | Rectifier | Feranti | ZS 70 | | |
| MR9 | Rectifier | Feranti | ZS 70 | | |
| DZ1 | Zener Diode | A.E.I. | MR 75 H | | 10% |
| DZ2 | Zener Diode | A.E.I. | MR 75 H | | 10% |
| DZ3 | Zener Diode | A.E.I. | MR 75 H | | 10% |
| M1 | Meter | Sifam | M -42 | | |
| C1 | Capcitor | Wima | 200 uF | 30 V | |
| C2 | Capacitor | Wima | 200 uF | 30 V | |
| C3 | Capacitor | Daly | 9000uF | 50 V | |
| C4 | Capacitor | Wima | 200 uF | 30 V | |
| C5 | Capacitor | Wima | 200 uF | 30 V | |
| C6 | Capacitor | Hunt | 500 uF | 25 V | |
| C7 | Capacitor | Mullard | 0.1 uF | 125 V | |
| C8 | Capacitor | Mullard | 2000uF | 125 V | |
| C9 | Capacitor | Mullard | 6.4 uF | 64 V | |
| C10 | Capacitor | Wima | 4700uF | 125 V | 20% |

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97 FARNHAM ROAD
SLOUGH, BUCKS.

| ITEM | DESCRIPTION | PART No. | No. OFF |
|---|---|---|---|
| MATERIAL | | [illegible]-A | |
| FINISH | | DRAWN BY- | |
| NAME COMPONENT LIST SHEET 1 | | CHECKED BY- | |
| ISSUE DATE 7.12.1964. | | SCALE | |
| | | USED ON LP-411/ | |

# DO NOT SCALE

UNLIMITED DIMENSIONS TO BE WITHIN ± ·005"
FRACTIONAL ± 1/64"

| Cir.Ref. | Description | Manufacturer | Value | Rat. | Tol.% |
|---|---|---|---|---|---|
| C11 | Capacitor | Plessey | 2000uF | 25 V | |
| C12 | Capacitor | Daly | 500 uF | 50 V | |
| RV1 | Var. Resistor | Colvern | 25 | 25 W | |
| RV2 | Var. Resistor | Radiospares | 1 K | ½ W | |
| RV3 | Var. Resistor | Colvern | 500 | ½ W | |
| RV4 | Var. Resistor | Colvern | 10 K | ½ W | |
| RV5 | Var. Resistor | Radiospares | 5 K | ½ W | |
| VT1 | Transistor | Mullard | OC 35 | | |
| VT2 | Transistor | Mullard | OC 35 | | |
| VT3 | Transistor | Mullard | OC 83 | | |
| VT4 | Transistor | Mullard | OC 83 | | |
| VT5 | Transistor | Mullard | OC 35 | | |
| VT6 | Transistor | Mullard | OC 35 | | |
| VT7 | Transistor | Mullard | ACY 21 | | |
| VT8 | Transistor | Mullard | ACY 21 | | |
| VT9 | Transistor | Mullard | ACY 21 | | |
| VT10 | Transistor | Mullard | ACY 21 | | |
| R1 | Resistor | Erie | 2.2 K | 1/4 W | 10% |
| R2 | Resistor | Erie | 47 | 1/4 W | 10% |
| R3 | Resistor | Erie | 2.2 K | 1/2 W | 10% |
| R4 | Resistor | Dubilier | 560 | 1/4 W | 10% |
| R5 | Resistor | Erie | 1 | 3 W | 10% |
| R6 | Resistor | Erie | 1 | 3 W | 10% |
| R7 | Resistor | Dubilier | 560 | 1/4 W | 10% |
| R8 | Resistor | Dubilier | 4.7 K | 1/4 W | 10% |
| R9 | Resistor | Dubilier | 100 | 1/4 W | 10% |
| R10 | Resistor | Dubilier | 5.6 K | 1/4 W | 10% |
| R11 | Resistor | Erie | 1.8 K | 1/4 W | 10% |
| R12 | Resistor | Erie | 1 K | 1/4 W | 10% |

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97 FARNHAM ROAD
SLOUGH, BUCKS.

| ITEM | DESCRIPTION | PART No. | No. OFF |
|---|---|---|---|
| MATERIAL | | D-0241-A | |
| FINISH | | DRAWN BY- | |
| NAME | COMPONENT LIST SHEET 2 | CHECKED BY- | |
| ISSUE | | SCALE | |
| DATE | 7.12.1964. | USED ON LP-411/P | |

DO NOT SCALE

UNLIMITED DIMENSIONS TO BE WITHIN ± ·005"
FRACTIONAL ± 1/64"

| Cir.Ref. | Description | Manufacturer | Value | Rat. | Tol.% |
|---|---|---|---|---|---|
| R13 | Resistor | Erie | 2.2 K | 1/4 W | 10% |
| R14 | Resistor | Erie | 1 K | 3 W | 10% |
| R15 | Resistor | Dubilier | 6.9 K | 1/4 W | 10% |
| R16 | Resistor | Erie | 1.6 | 3 W | 10% |
| R17 | Resistor | Dubilier | 15 K | 1/4 W | 10% |
| R18 | Resistor | Dubilier | 470 | 1/4 W | 10% |
| R19 | Resistor | Erie | 68 | 1/4 W | 10% |
| R20 | Resistor | Dubilier | 220 | 1/4 W | 10% |
| R21 | Resistor | Dubilier | 470 | 1/4 W | 10% |
| R22 | Resistor | Dubilier | 2.2 K | 1/4 W | 10% |
| R23 | Resistor | Dubilier | 2.2 K | 1/4 W | 10% |
| R24 | Resistor | Dubilier | 1.9 K | 1/4 W | 10% |
| R25 | Resistor | Dubilier | 560 | 1/4 W | 10% |
| R26 | Resistor | Dubilier | 15 K | 1/4 W | 10% |
| R27 | Resistor | Dubilier | 220 | 1/4 W | 10% |
| R28 | Resistor | Dubilier | 1 K | 1/4 W | 10% |
| R29 | Resistor | Dubilier | 10 K | 1/4 W | 10% |
| R30 | Resistor | Dubilier | 560 | 1/4 W | 10% |
| R31 | Resistor | Dubilier | 330 | 1/4 W | 10% |
| R32 | Resistor | Dubilier | 560 | 1/4 W | 10% |
| R33 | Resistor | Erie | 1 | 3 W | 10% |
| R34 | Resistor | Erie | 1 | 3 W | 10% |
| R35 | Resistor | Erie | 1 | 3 W | 10% |

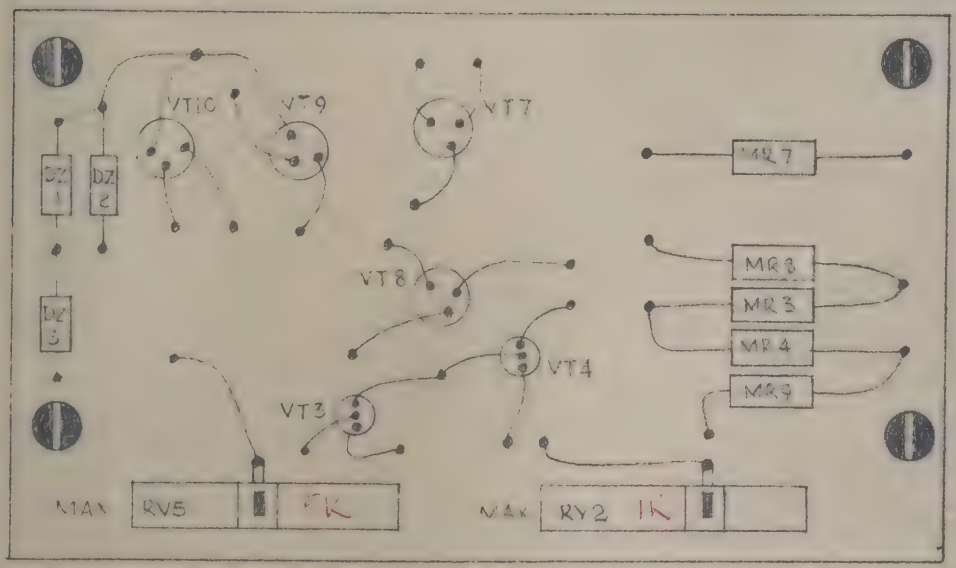
Lan-Elec LIMITED

97 FARNHAM ROAD
SLOUGH, BUCKS.

| ITEM | DESCRIPTION | PART No. | No. OFF |
|---|---|---|---|
| MATERIAL | | D-241 -A | |
| FINISH | | DRAWN BY- | |
| NAME COMPONENT LIST SHEET 3 | | CHECKED BY- | |
| ISSUE<br>DATE 7.12.1964. | | SCALE | |
| | | USED ON LP-411/1 | |

# DO NOT SCALE

UNLIMITED DIMENSIONS
TO BE WITHIN ± ·005"
FRACTIONAL ± 1/64"

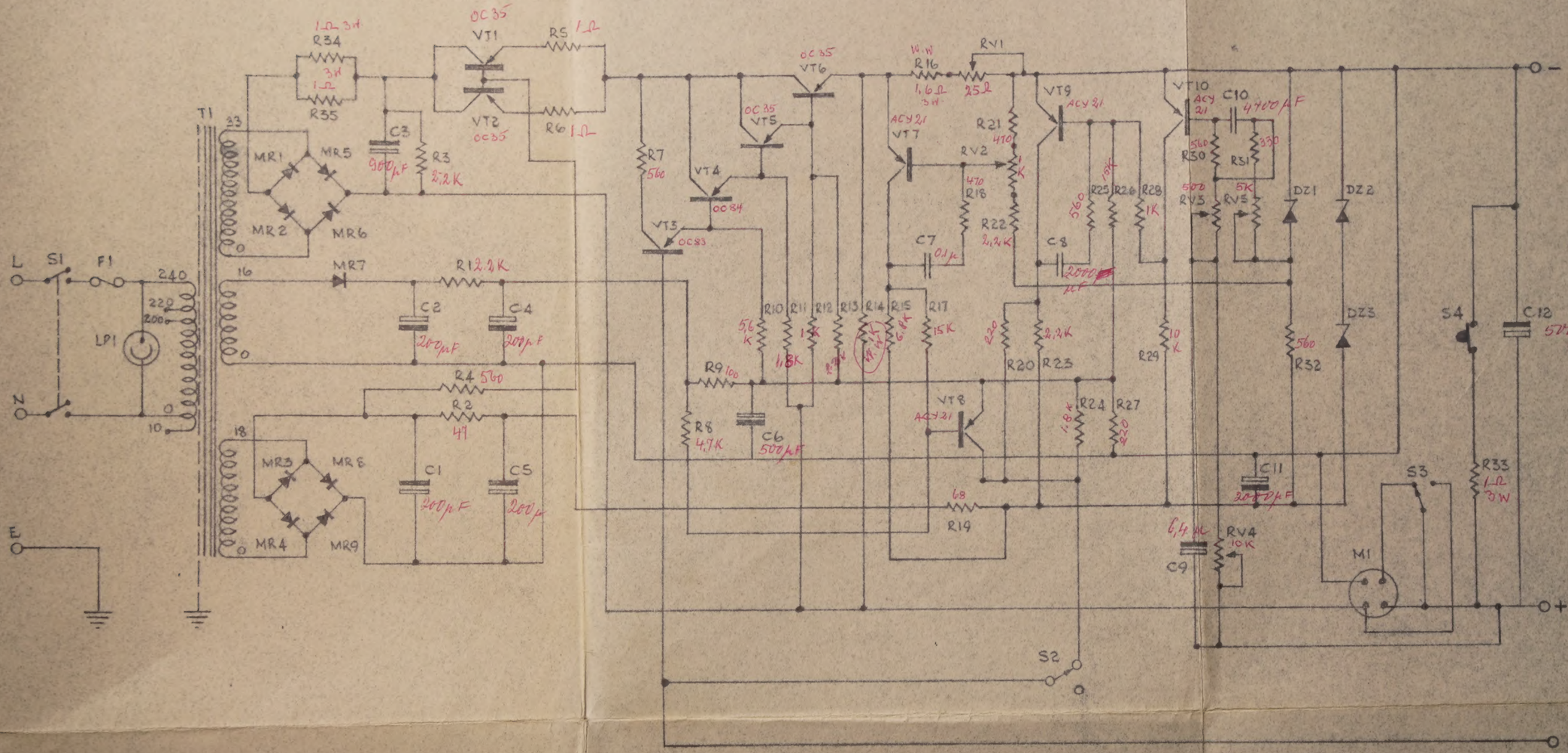



TRANSISTOR COLOUR CODE :-
COLLECTOR....BLUE
BASE.....WHITE
EMITTER .....GREEN

| | | | |
|---|---|---|---|
| Lan-Elec LIMITED<br>97 FARNHAM ROAD<br>SLOUGH, BUCKS. | ITEM / DESCRIPTION | PART No. | No. OFF |
| | MATERIAL | D-0237-A | |
| | FINISH | DRAWN BY- | |
| | NAME PRESET AND SEMICONDUCTOR LAYOUT ON CIRCUIT BOARD | CHECKED BY- | |
| ISSUE ONE<br>DATE 3.12.64 | | SCALE | |
| | | USED ON LP411/P | |

DO NOT SCALE

UNLIMITED DIMENSIONS
TO BE WITHIN ± ·005"
FRACTIONAL ± 1/64"




a little lamp 14 fitted (subminiature - Vitabulb type) not in diagram (There is R19 instead)

~~Diode~~ is fitted since 27.1.67.

| | | | |
|---|---|---|---|
| Lan-Elec LIMITED<br>97 FARNHAM ROAD<br>SLOUGH, BUCKS. | ITEM / DESCRIPTION | PART No. | No. OFF |
| | MATERIAL | D-0236-C | |
| | FINISH | DRAWN BY- | |
| | NAME CIRCUIT DIAGRAM | CHECKED BY- | |
| ISSUE ONE<br>DATE 2.12.64 | | SCALE | |
| | | USED ON LP411/P | |

MP MASTER
MA23305